

MODIS Atmosphere Products

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- MODIS atmosphere products
 - Contents and changes in Collection 5
 - Examples from Aqua (*Collection 5*)
 - ✓ Cloud fraction
 - ✓ Cloud top properties
 - ✓ Cloud optical & microphysical properties
 - » Uncertainties
 - » Multilayer flag
 - ✓ Aerosol properties
 - » Deep blue algorithm for desert surfaces
 - ✓ Water vapor
 - ✓ Zonal cross sections
 - Probability density functions (*Collection 4*)
- Collection 5
 - Processing schedule



Gridded Level-3 Joint Atmosphere Products

(M. D. King, S. Platnick, P. A. Hubanks - NASA GSFC)

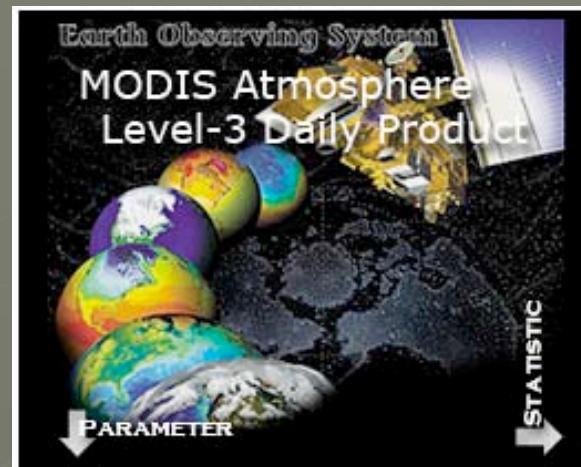
- Daily, 8-day, and monthly products (97, 255, 255 MB)
 - 20-25% of the size of these products in Collection 4
 - Files contain more SDSs, but are stored with internal hdf compression
- $1^\circ \times 1^\circ$ equal angle grid
- Statistics
 - Mean, standard deviation, minimum, maximum
 - QA mean, QA standard deviation
 - Cloud fraction, pixel counts
 - Log mean, log standard deviation (useful for cloud inhomogeneity studies)
 - Mean uncertainty, QA mean uncertainty
 - Marginal probability density functions for cloud properties
 - ✓ Histogram counts, confidence histograms
 - Joint probability density functions
 - ✓ Joint histograms between various cloud properties (e.g., cloud optical thickness vs cloud top pressure)

Daily Global (08_D3) statistics from Cloud (06_L2)

Collection 5 Updates

- Added
- Renamed
- Deleted

- Cloud Optical Properties
 - ✓ Primary Retrieval



**Earth Observing System
MODIS Atmosphere
Level-3 Daily Product**

PARAMETER → **STATISTIC**

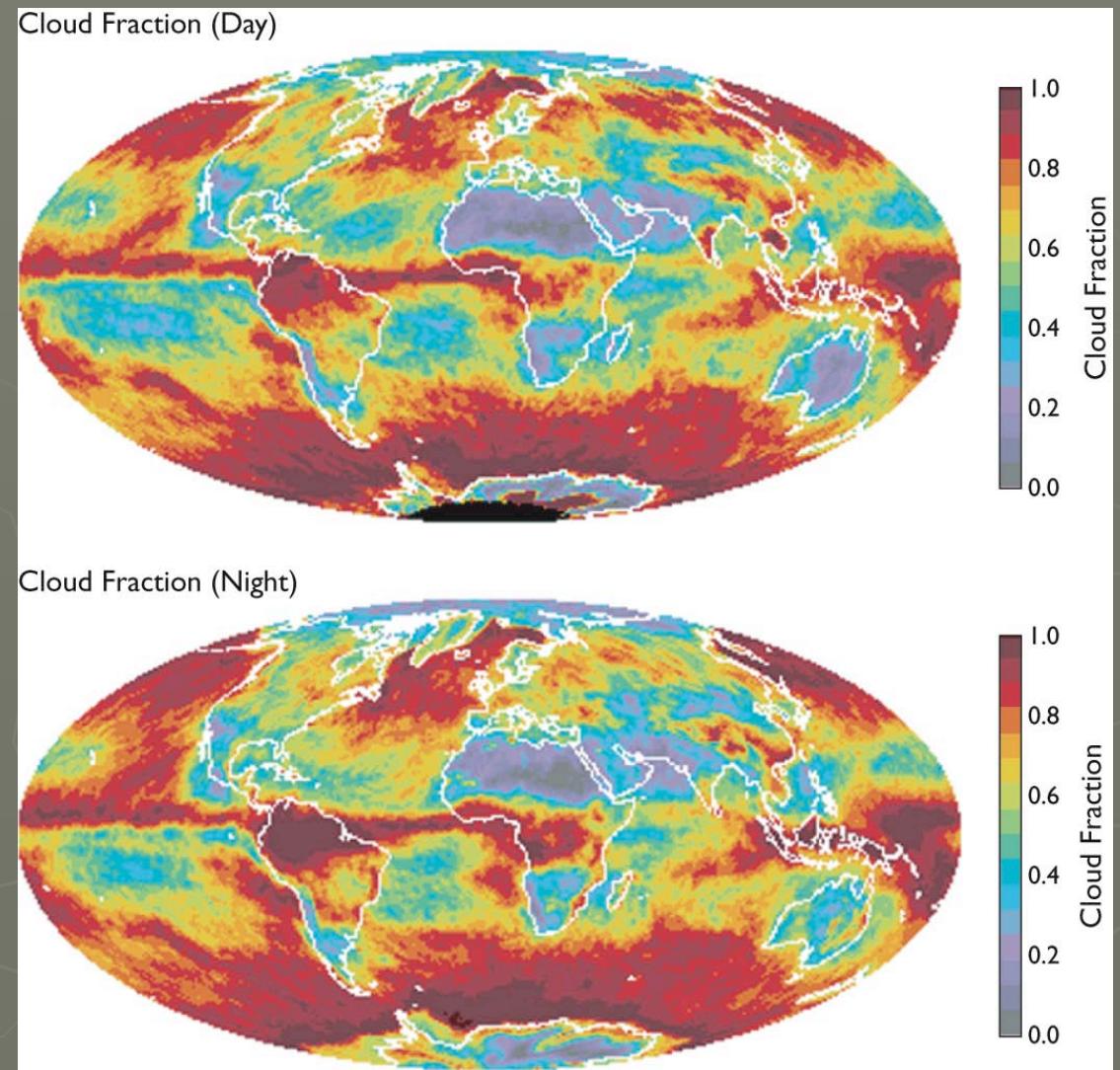
	Mean	Standard Deviation	Minimum	Maximum	QA Mean	QA Standard Deviation	Histogram Counts (n)	Confidence Histogram (4)	Fraction	Pixel Counts	Mean Uncertainty	QA Mean Uncertainty	Log Mean Uncertainty	QA Log Mean Uncertainty	Log Mean	Log Standard Deviation	QA Log Mean	QA Log Standard Deviation	Regression Slope	Regression Intercept	Regression R-Squared	Regression Mean Square Error	Joint Histogram vs Effect Radius (nm)	Joint Histogram vs Temperature (nm)	Joint Histogram vs Emissivity (nm)	Joint Histogram vs Pressure (mm)
Derived from L2 Cloud (06_L2)																										
Cloud Optical Properties (Primary Retrieval)																										
58. Cloud_Optical_Thickness_Liquid	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
59. Cloud_Optical_Thickness_Ice	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
60. Cloud_Optical_Thickness_Undetermined	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
61. Cloud_Optical_Thickness_Combined	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
62. Cloud_Optical_Thickness_ISCCP [®]																										•
63. Cloud_Effective_Radius_Liquid	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
64. Cloud_Effective_Radius_Ice	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
65. Cloud_Effective_Radius_Undetermined	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
66. Cloud_Effective_Radius_Combined	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
67. Cloud_Water_Path_Liquid	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
68. Cloud_Water_Path_Ice	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
69. Cloud_Water_Path_Undetermined	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
70. Cloud_Water_Path_Combined	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
71. Cloud_Phase_Optical_Properties																										•
(Primary Cloud Fraction)																										
72. Cloud_Fraction_Liquid																			•	•						
73. Cloud_Fraction_Ice																			•	•						
74. Cloud_Fraction_Undetermined																			•	•						
75. Cloud_Fraction_Combined																			•	•						

Full details at
modis-atmos.gsfc.nasa.gov

Monthly Mean Cloud Fraction

(S. A. Ackerman, R. A. Frey et al. - Univ. Wisconsin)

April 2005 (Collection 5)
Aqua

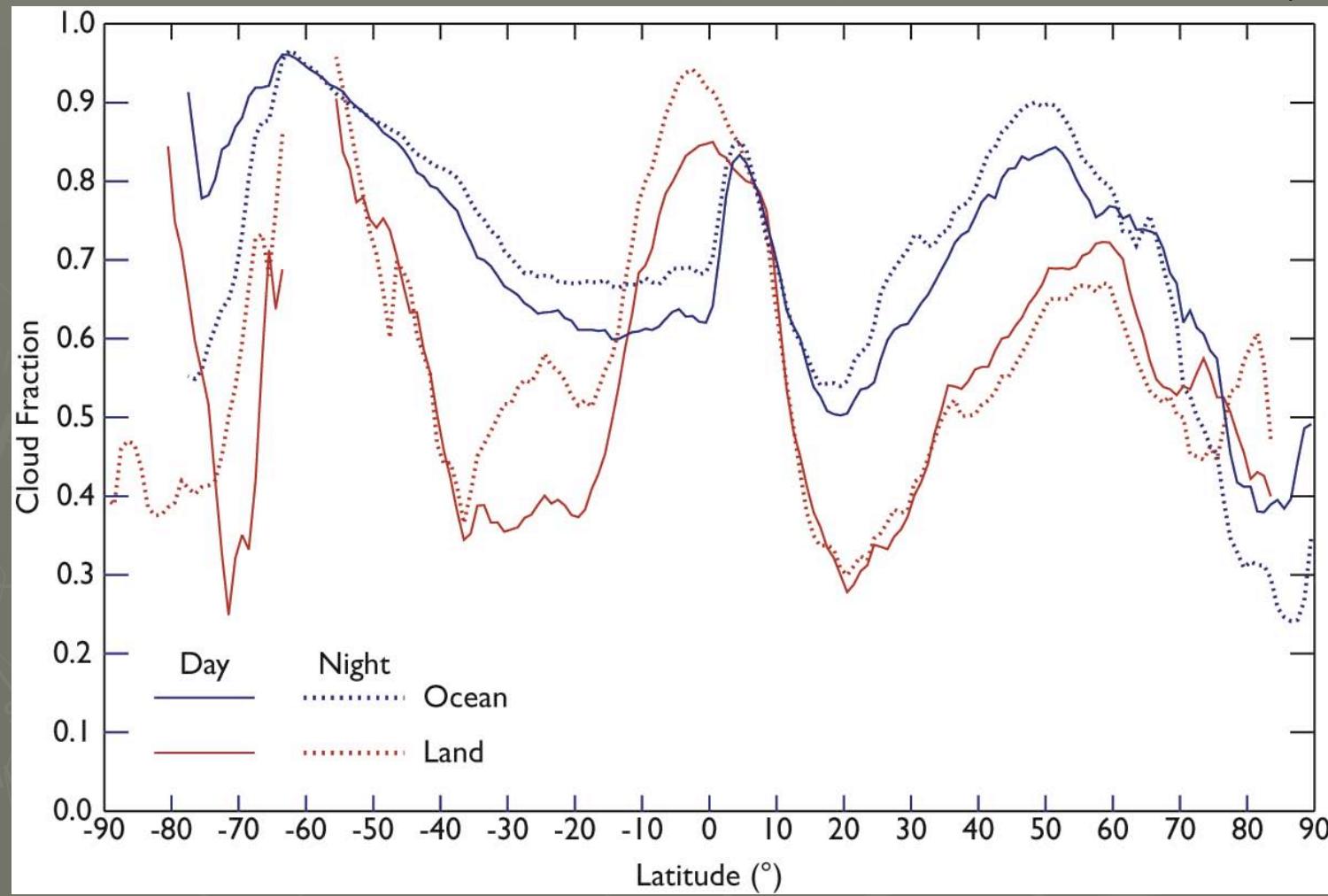


Zonal Mean Cloud Fraction

(S. A. Ackerman, R. A. Frey et al. - Univ. Wisconsin)

April 2005 (Collection 5)

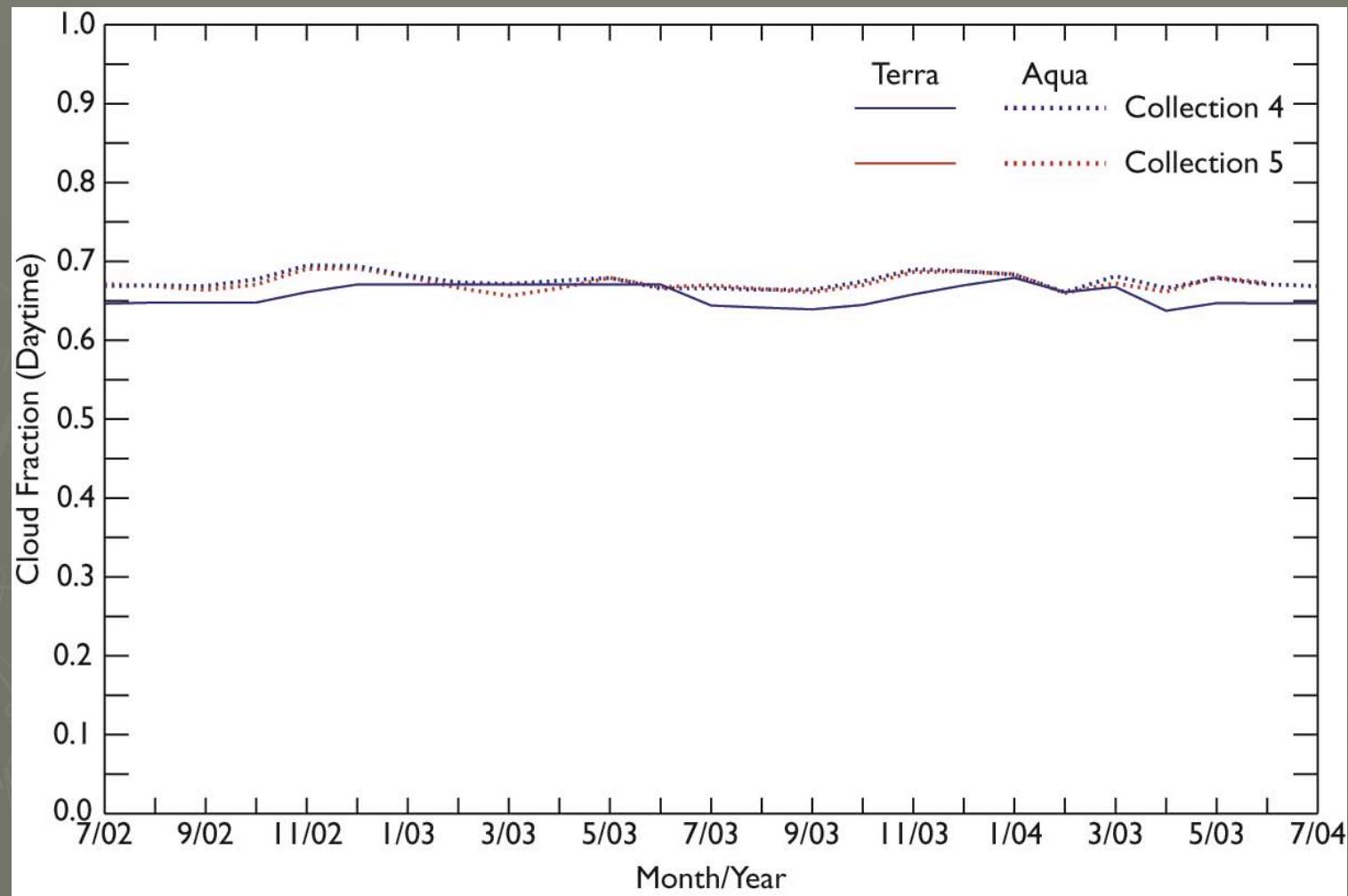
Aqua



Time Series of Cloud Fraction during the Daytime

(M. D. King, S. Platnick et al. - NASA GSFC)

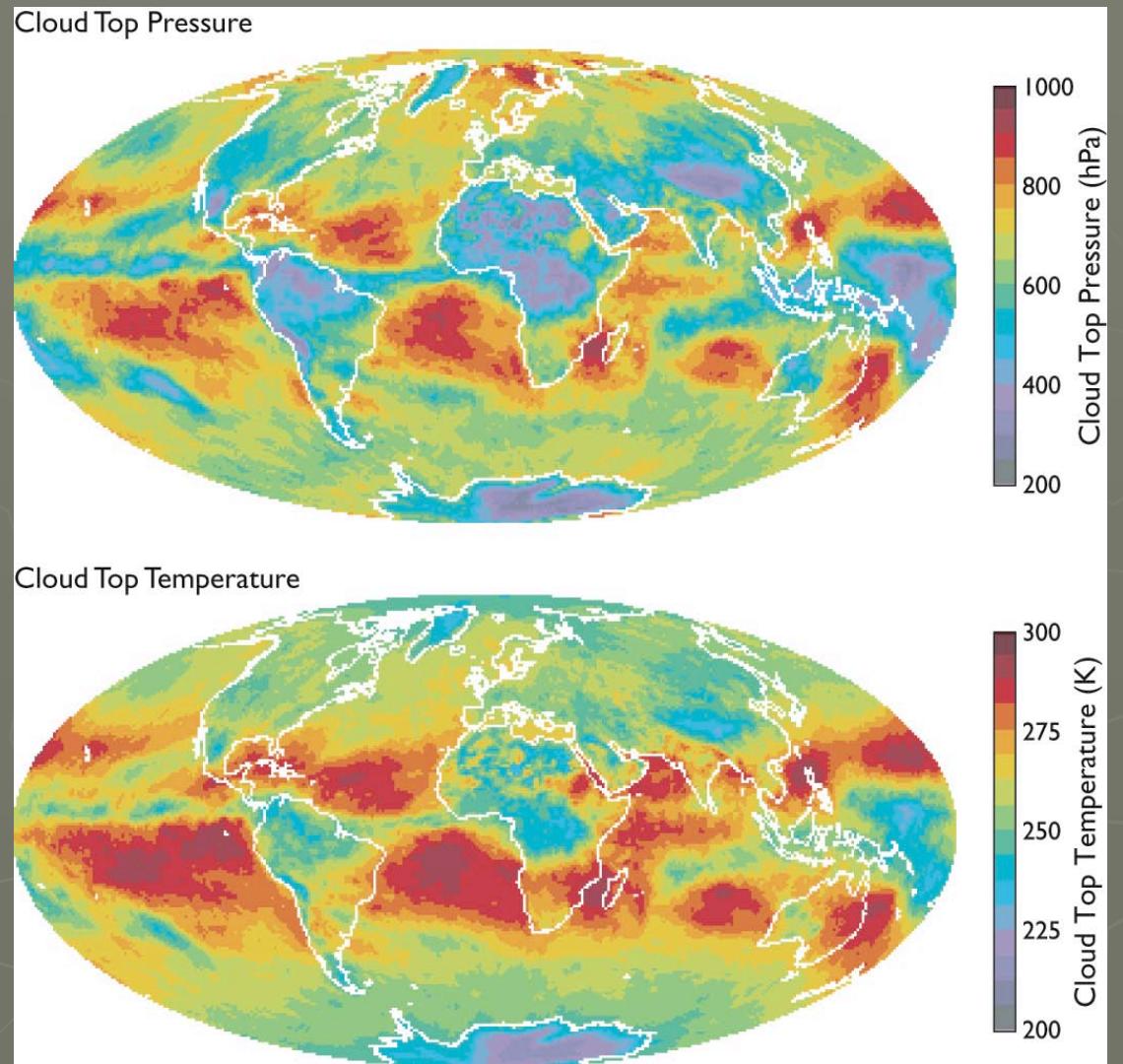
July 2002 - July 2004



Monthly Mean Cloud Top Properties

(W. P. Menzel, R. A. Frey et al. - NOAA, Univ. Wisconsin)

April 2005 (Collection 5)
Aqua

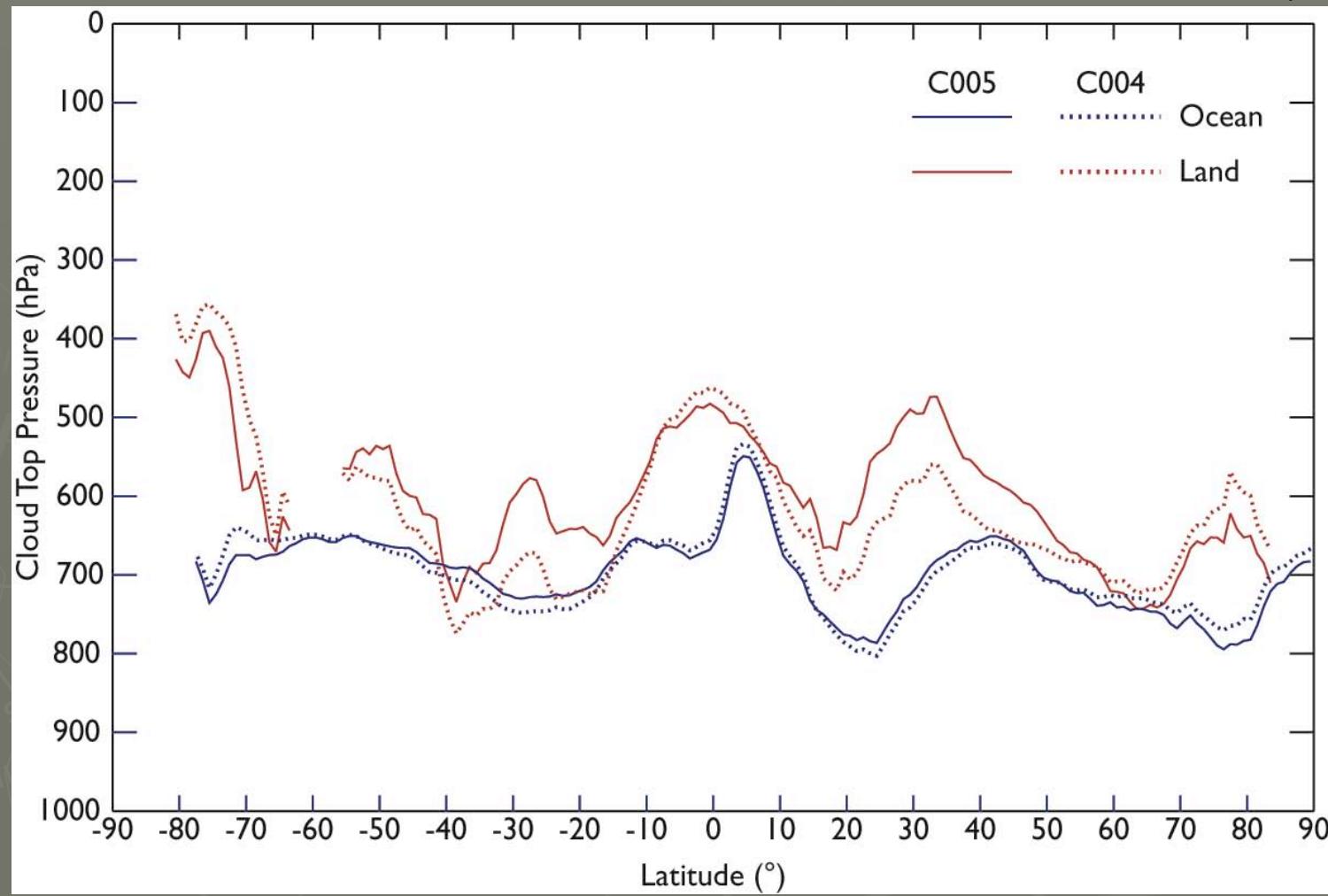


Zonal Mean Cloud Top Pressure

(W. P. Menzel, R. A. Frey et al. - NOAA, Univ. Wisconsin)

April 2005 (Collection 5)

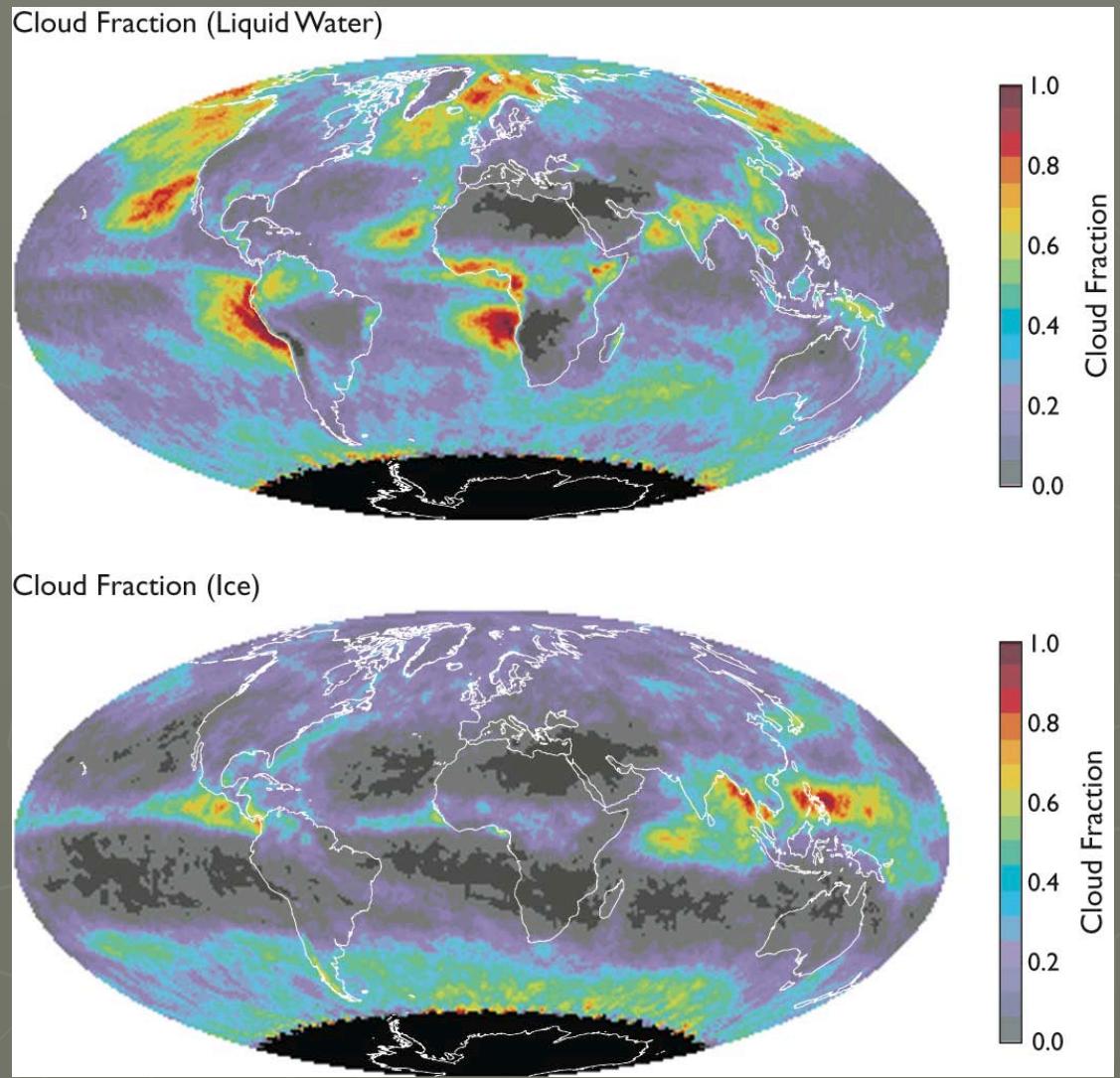
Aqua



Monthly Mean Cloud Fraction by Phase

(M. D. King, S. Platnick et al. - NASA GSFC)

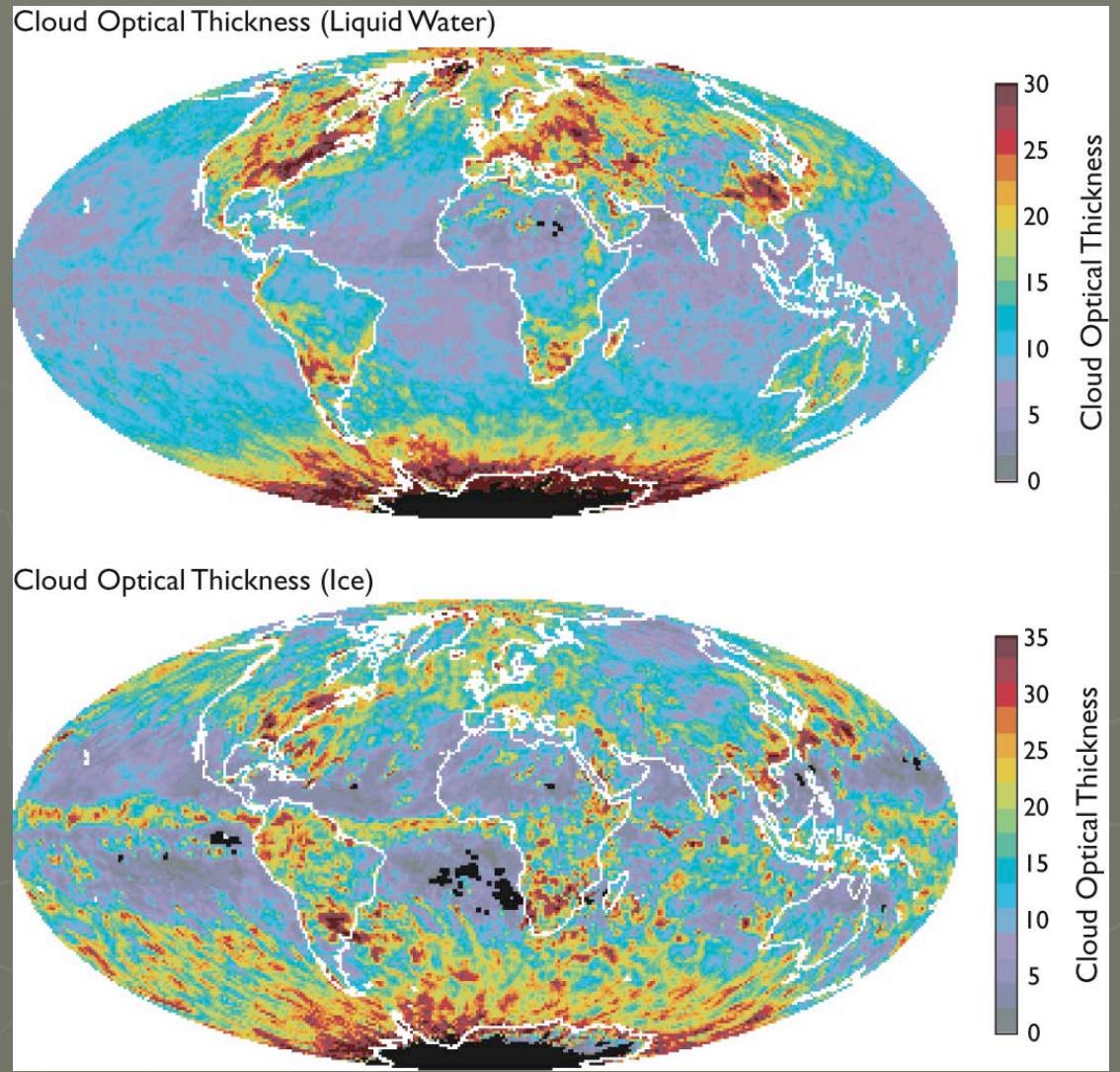
July 2006 (Collection 5)
Terra



Monthly Mean Cloud Optical Thickness

(M. D. King, S. Platnick et al. - NASA GSFC)

April 2005 (Collection 5)
Aqua (QA Mean)

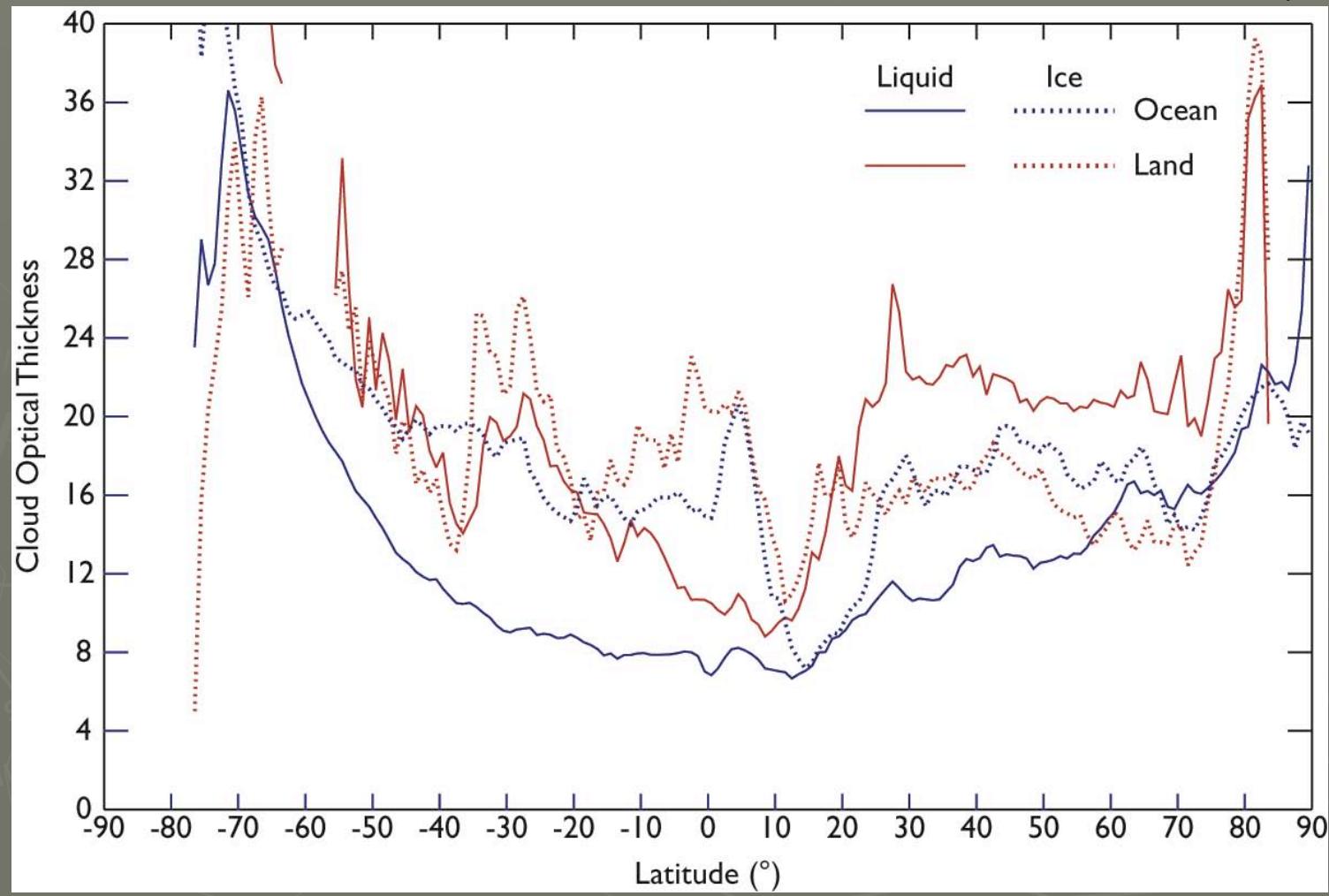


Zonal Mean Cloud Optical Thickness

(M. D. King, S. Platnick et al. - NASA GSFC)

April 2005 (Collection 5)

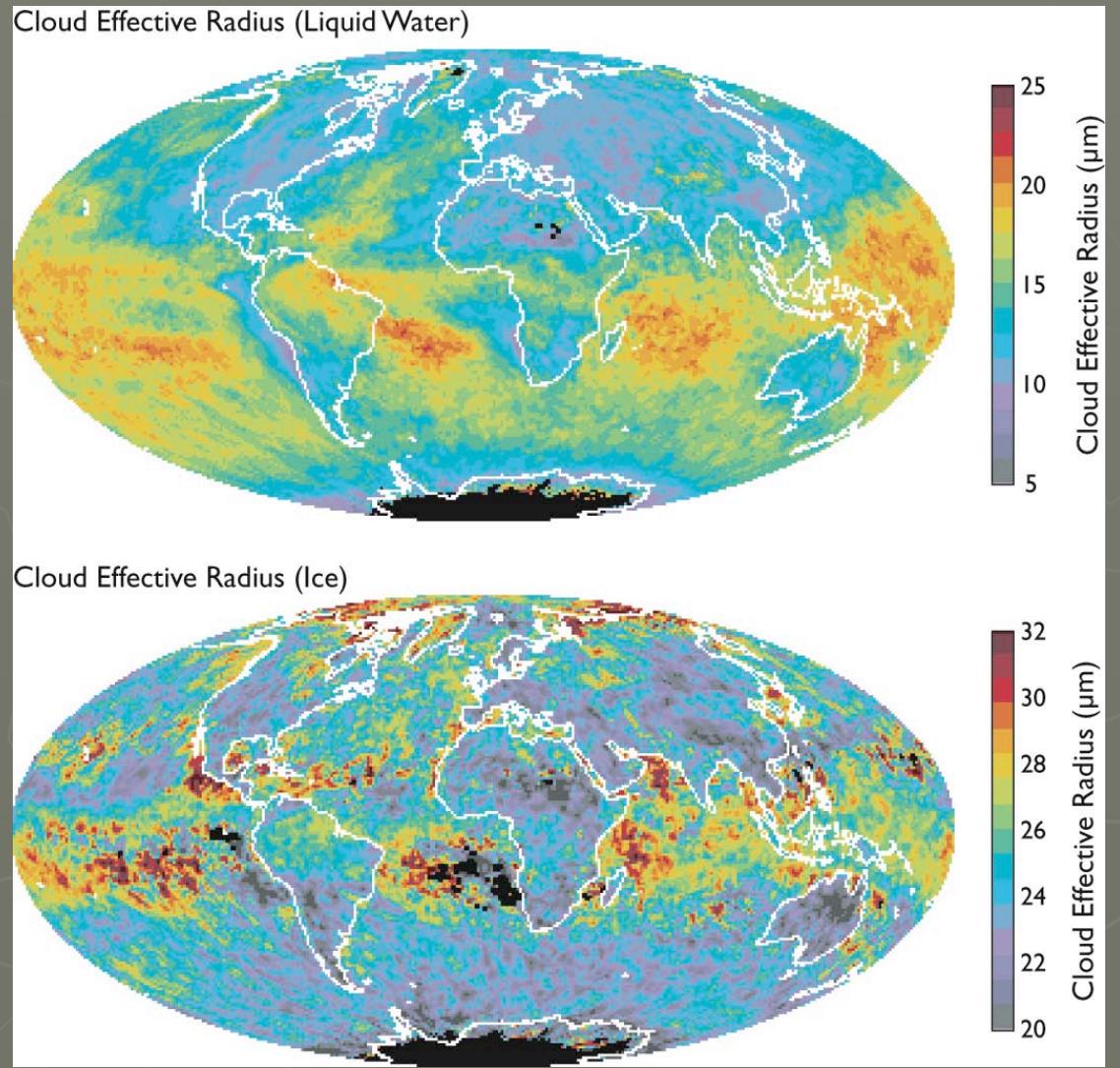
Aqua



Monthly Mean Cloud Effective Radius

(M. D. King, S. Platnick et al. - NASA GSFC)

April 2005 (Collection 5)
Aqua (QA Mean)

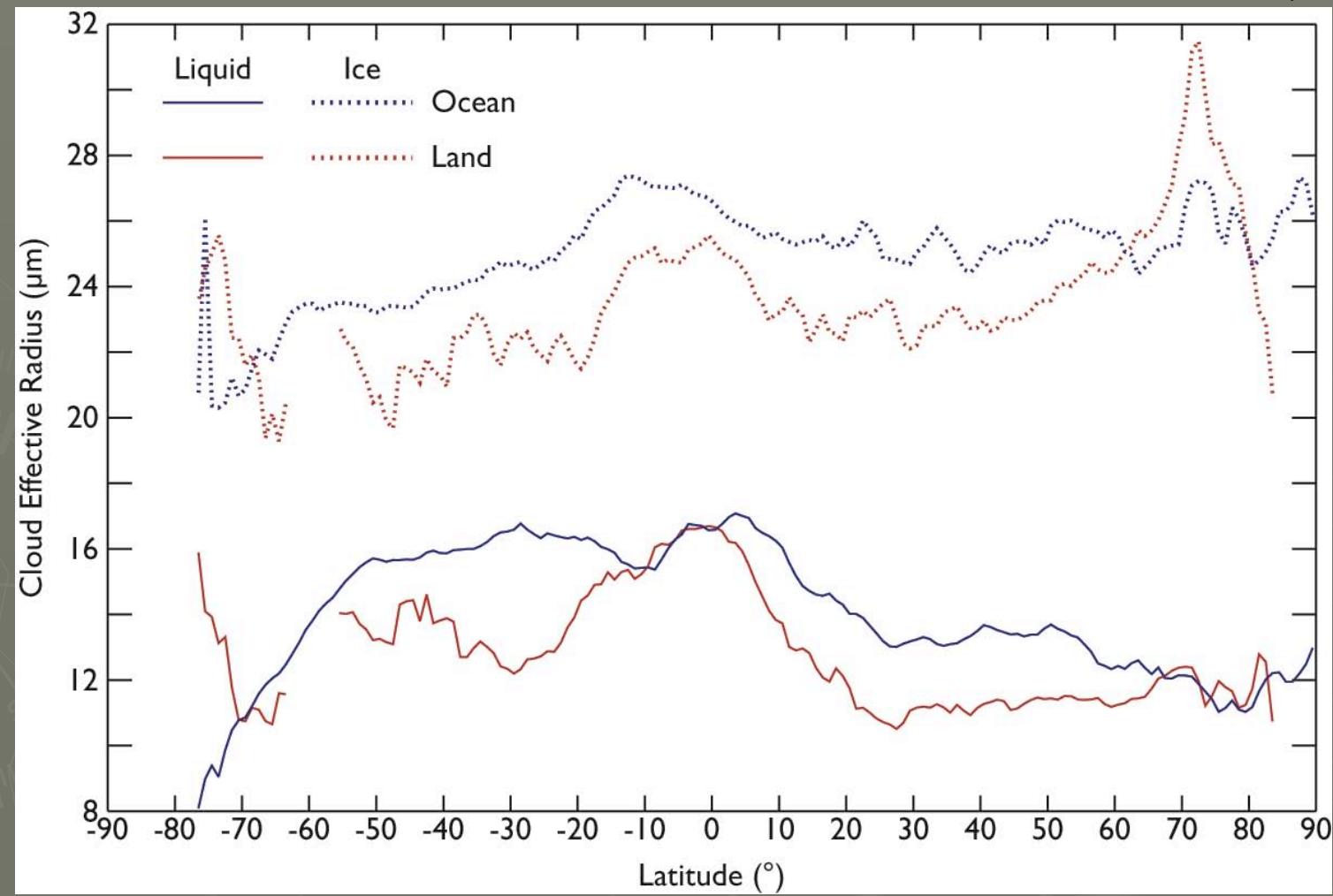


Zonal Mean Cloud Effective Radius

(M. D. King, S. Platnick et al. - NASA GSFC)

April 2005 (Collection 5)

Aqua



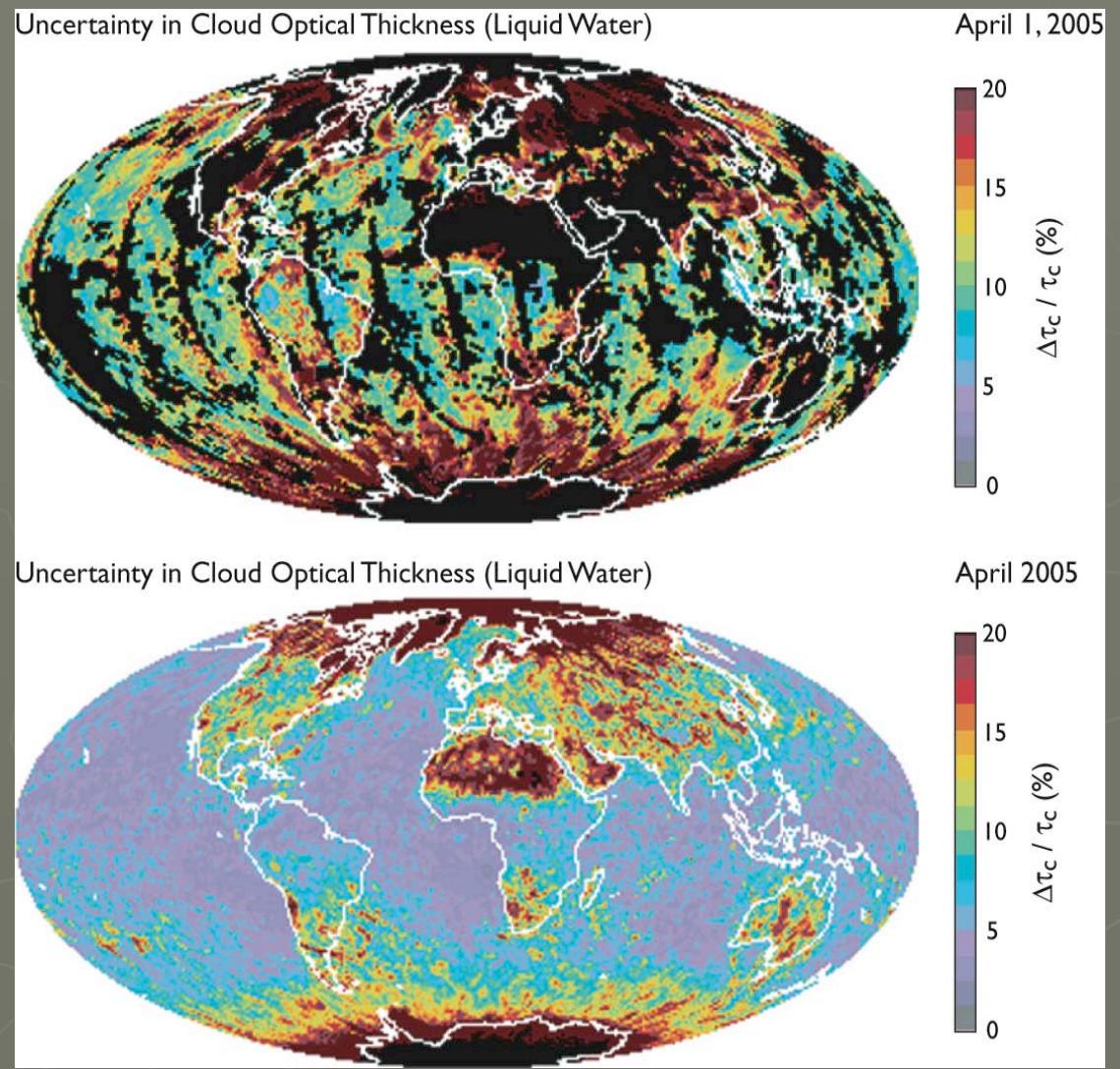
Cloud Optical Thickness Uncertainties

(S. Platnick, R. Pincus, M. D. King et al. - NASA GSFC, NOAA CDC)

Liquid Water Cloud (Collection 5)
 $\Delta\tau_c / \tau_c$ (%)

Daily Aggregation (Aqua)
(correlation between pixels = 1)

Monthly Aggregation (Aqua)
(daily uncertainties uncorrelated)



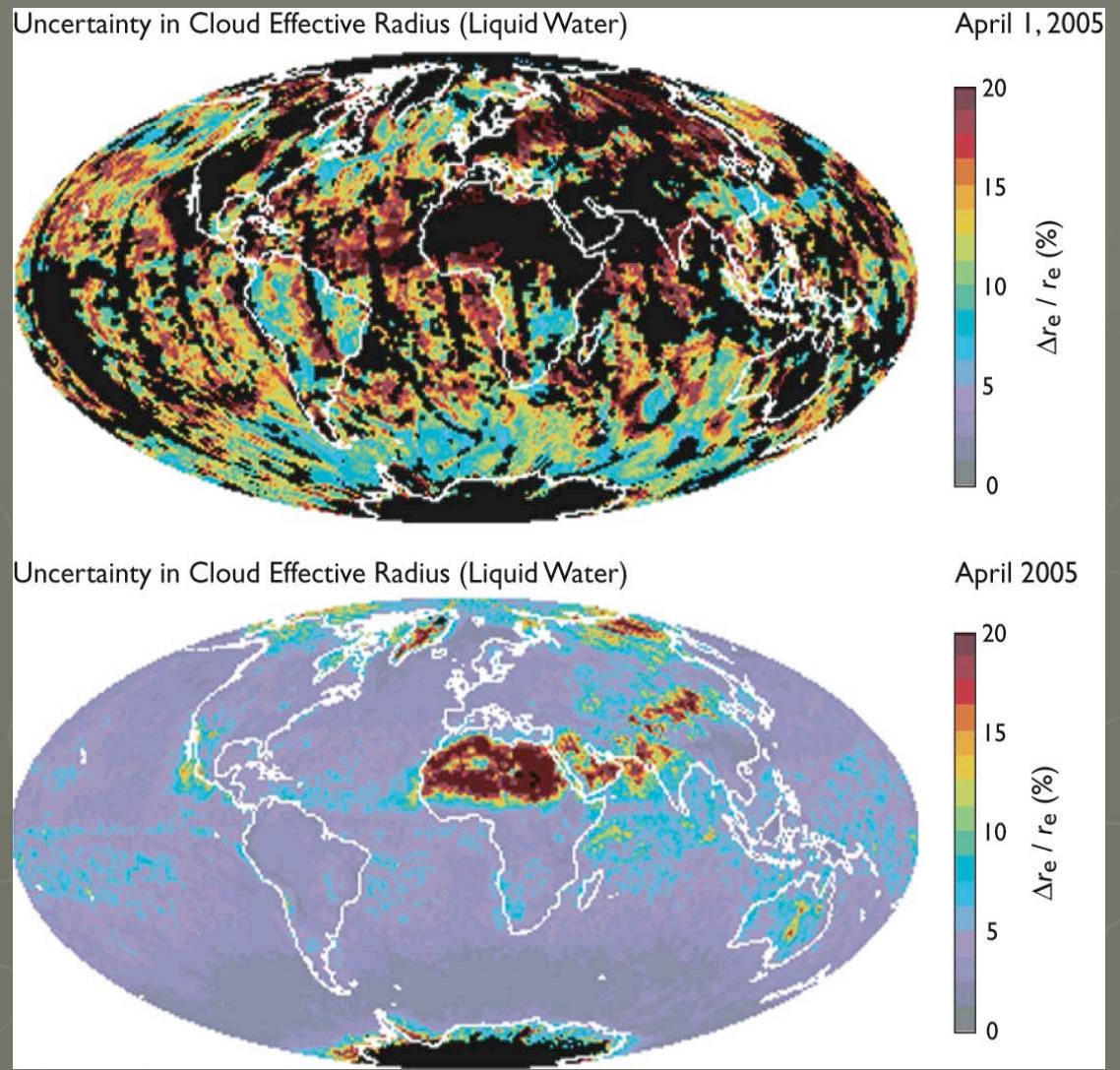
Cloud Effective Radius Uncertainties

(S. Platnick, R. Pincus, M. D. King et al. - NASA GSFC, NOAA CDC)

Liquid Water Cloud (Collection 5)
 $\Delta r_e / r_e (\%)$

Daily Aggregation (Aqua)
(correlation between pixels = 1)

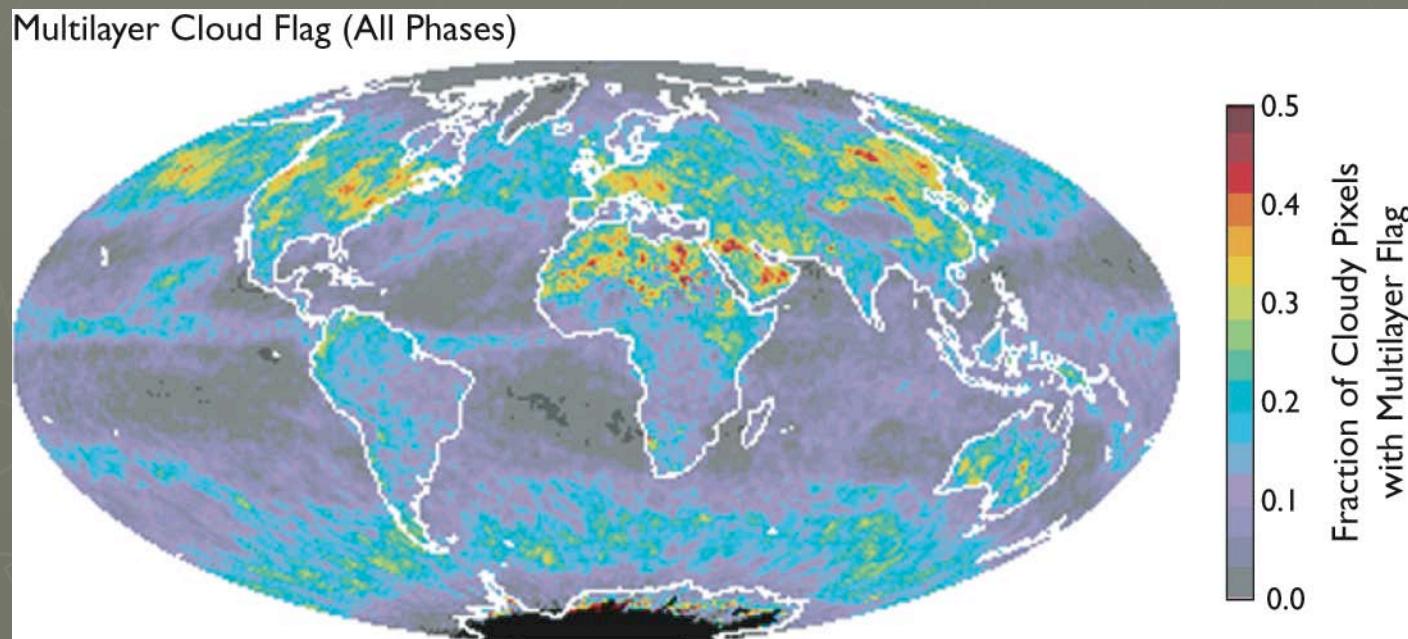
Monthly Aggregation (Aqua)
(daily uncertainties uncorrelated)



Multilayer Cloud Flag

(S. Platnick, M. D. King et al. - NASA GSFC)

April 2005 (Collection 5)
Aqua

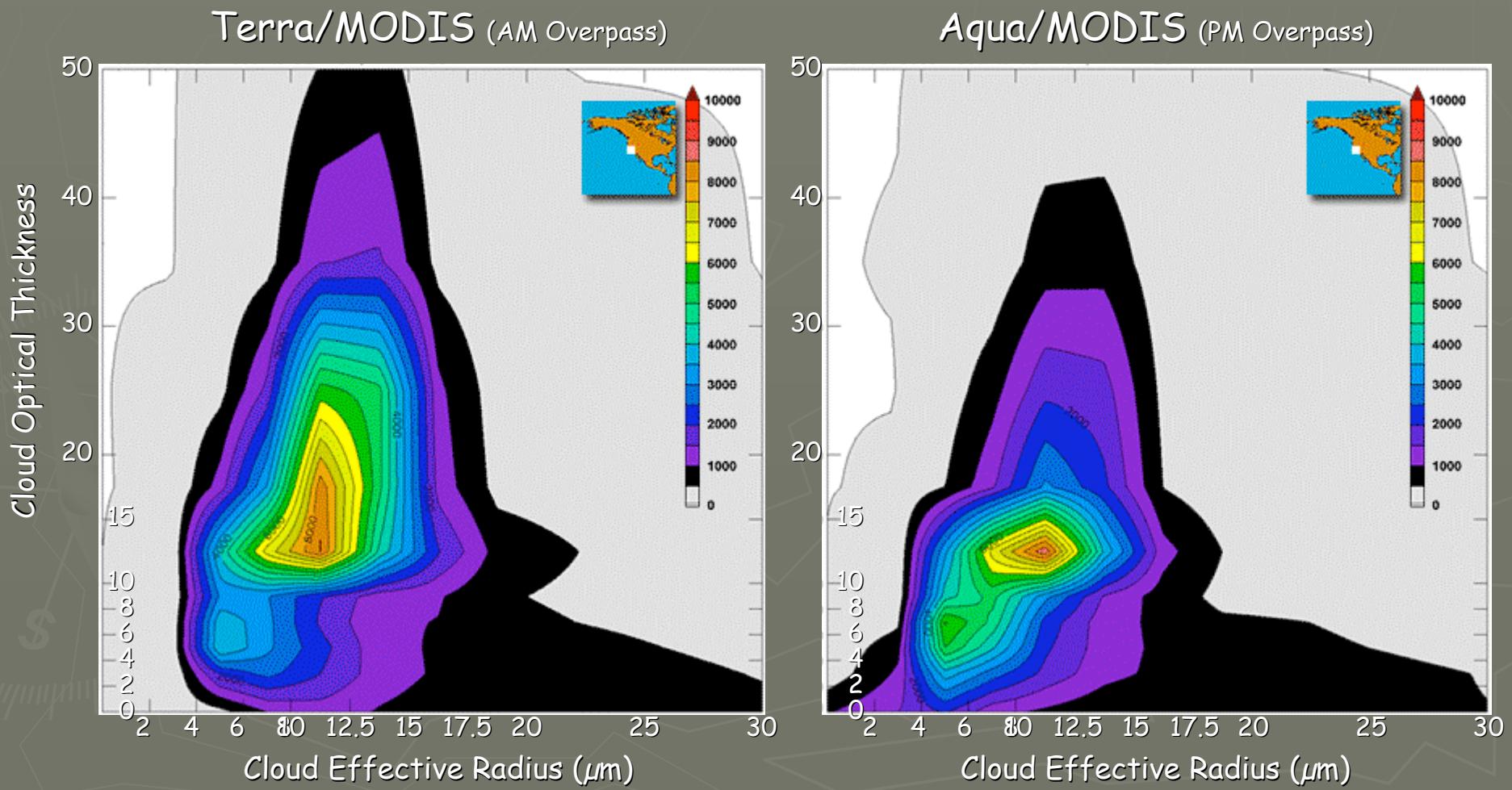


California / California Current Regime

Monthly Joint Histogram Counts of Liquid Water Clouds over Ocean

32°-40°N, 117°-125°W

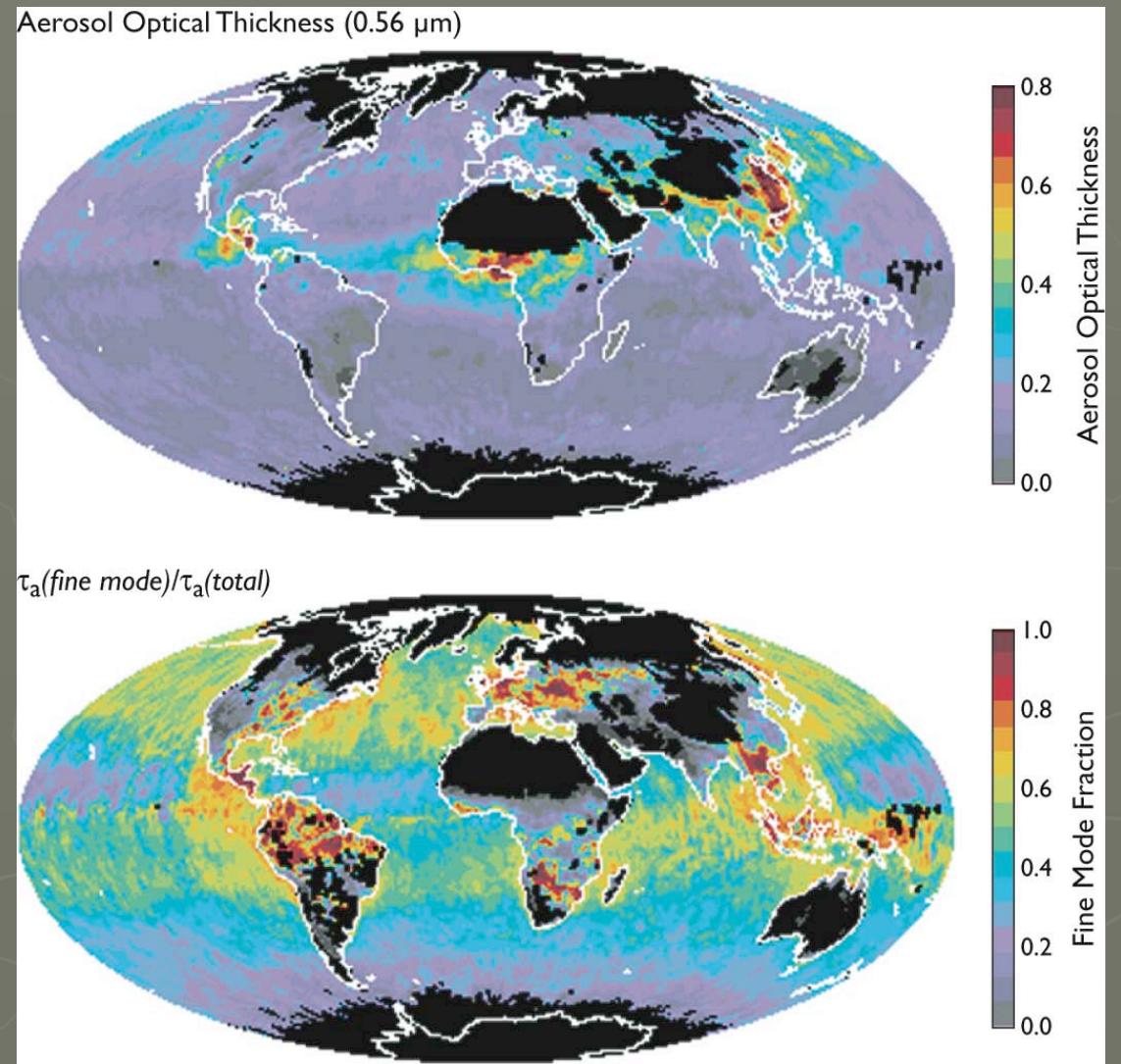
June 2003



Monthly Mean Aerosol Optical Properties

(L. A. Remer, Y. J. Kaufman, and D. Tanré et al. - GSFC, Univ. Lille)

April 2005 (Collection 5)
Aqua

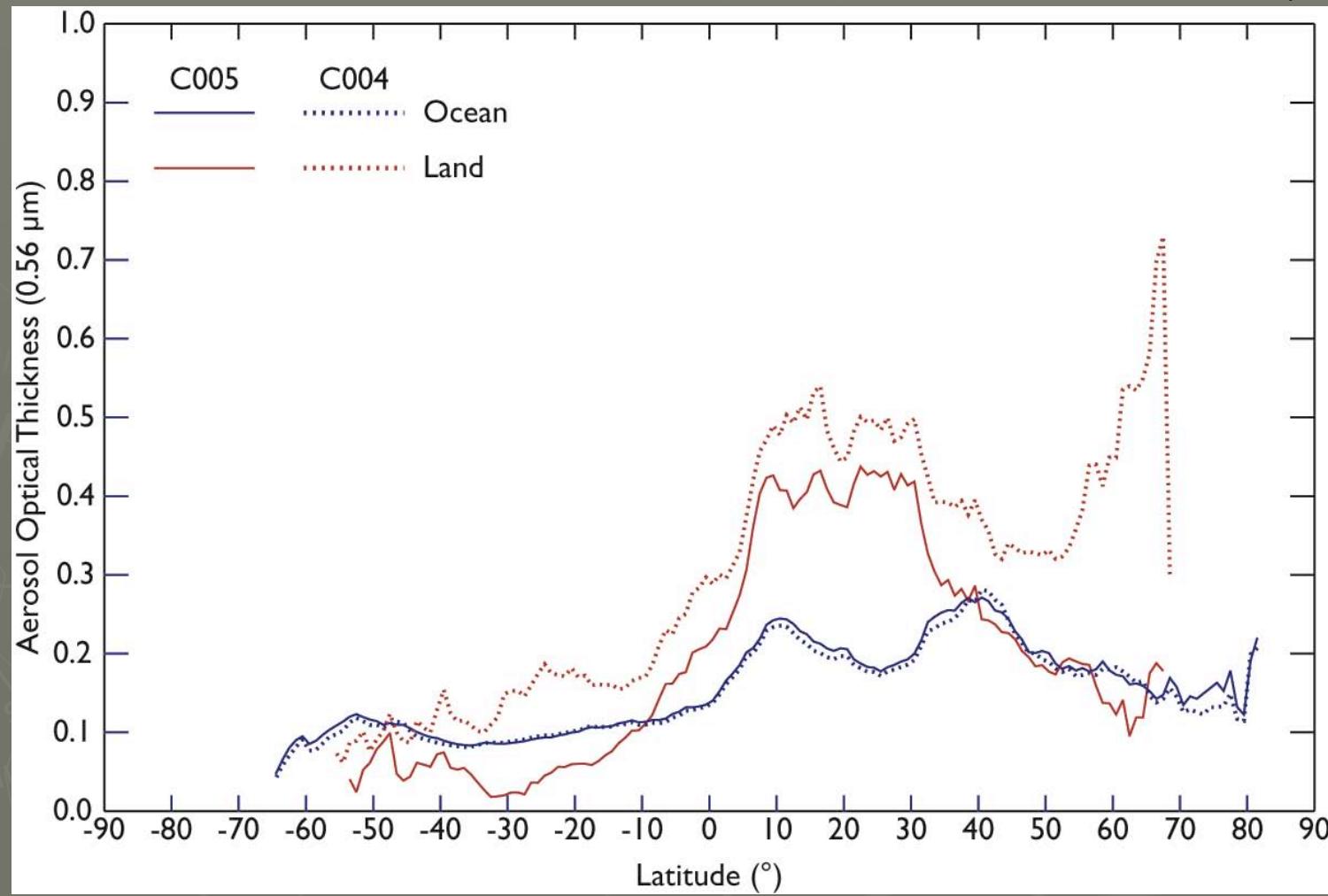


Zonal Mean Aerosol Optical Thickness

(L. A. Remer, Y. J. Kaufman, and D. Tanré et al. - GSFC, Univ. Lille)

April 2005 (Collection 5)

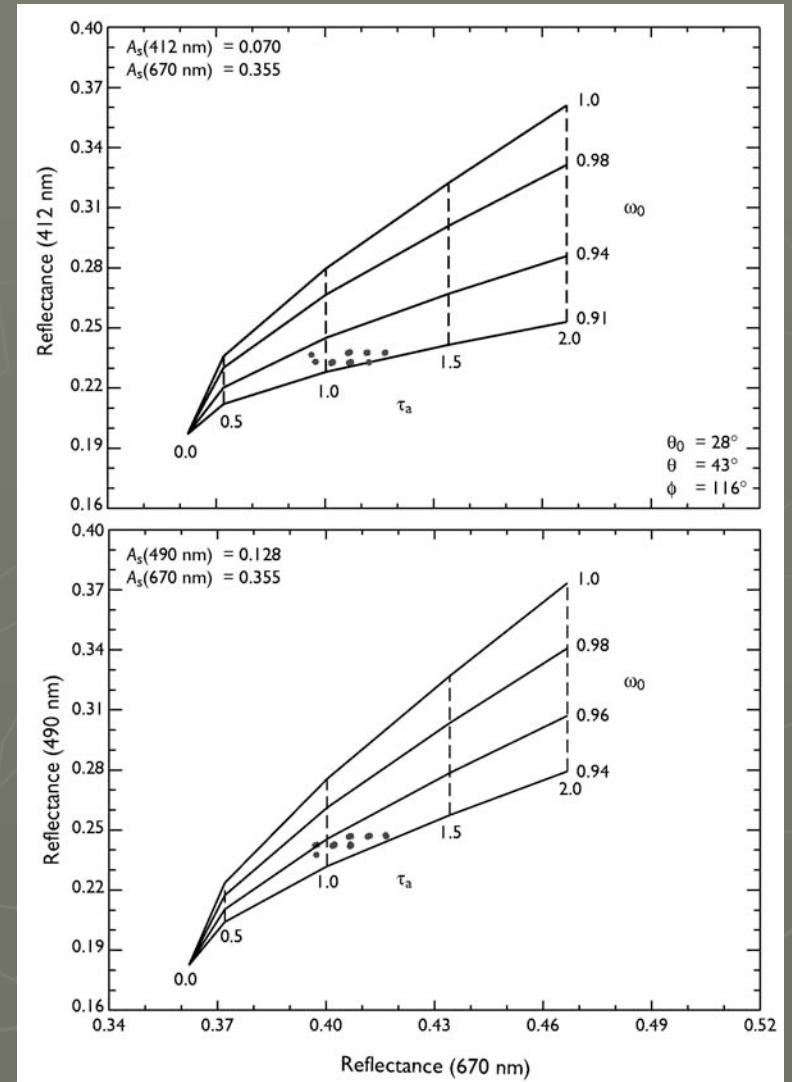
Aqua



Deep Blue Algorithm for SeaWiFS & MODIS

(N. C. Hsu, S. C. Tsay, M. D. King, and J. R. Herman - NASA GSFC)

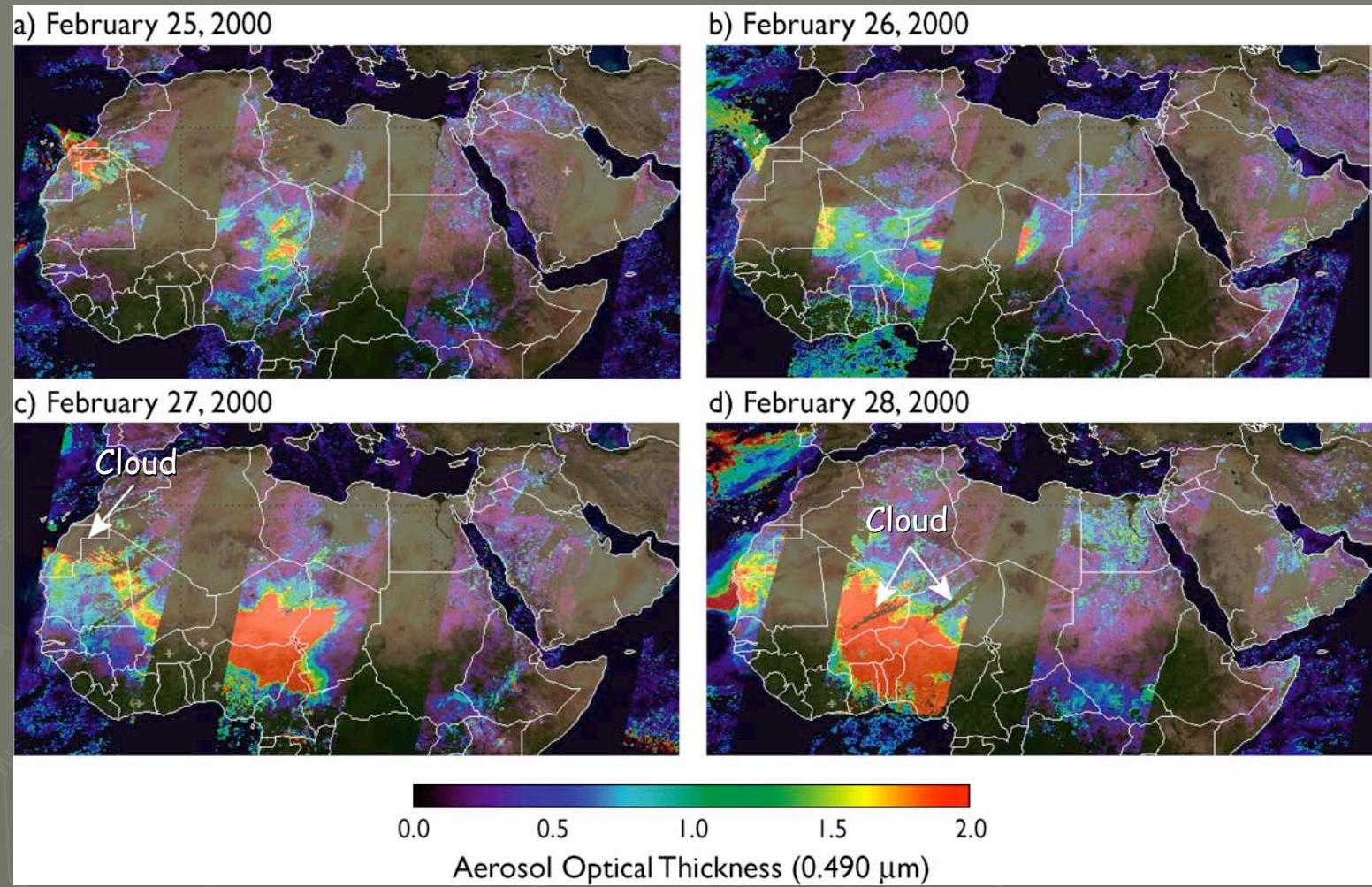
- Utilize solar reflectance at $\lambda = 412, 490,$ and 670 nm to retrieve aerosol optical thickness (τ_a) and single scattering albedo (ω_0)
- Less sensitive to aerosol height, compared to UV methods
- Works well on retrieving aerosol properties over various types of surfaces, including very bright desert



Aerosol Optical Thickness of Dust plumes in Africa

(N. C. Hsu, S. C. Tsay, M. D. King, and J. R. Herman - NASA GSFC)

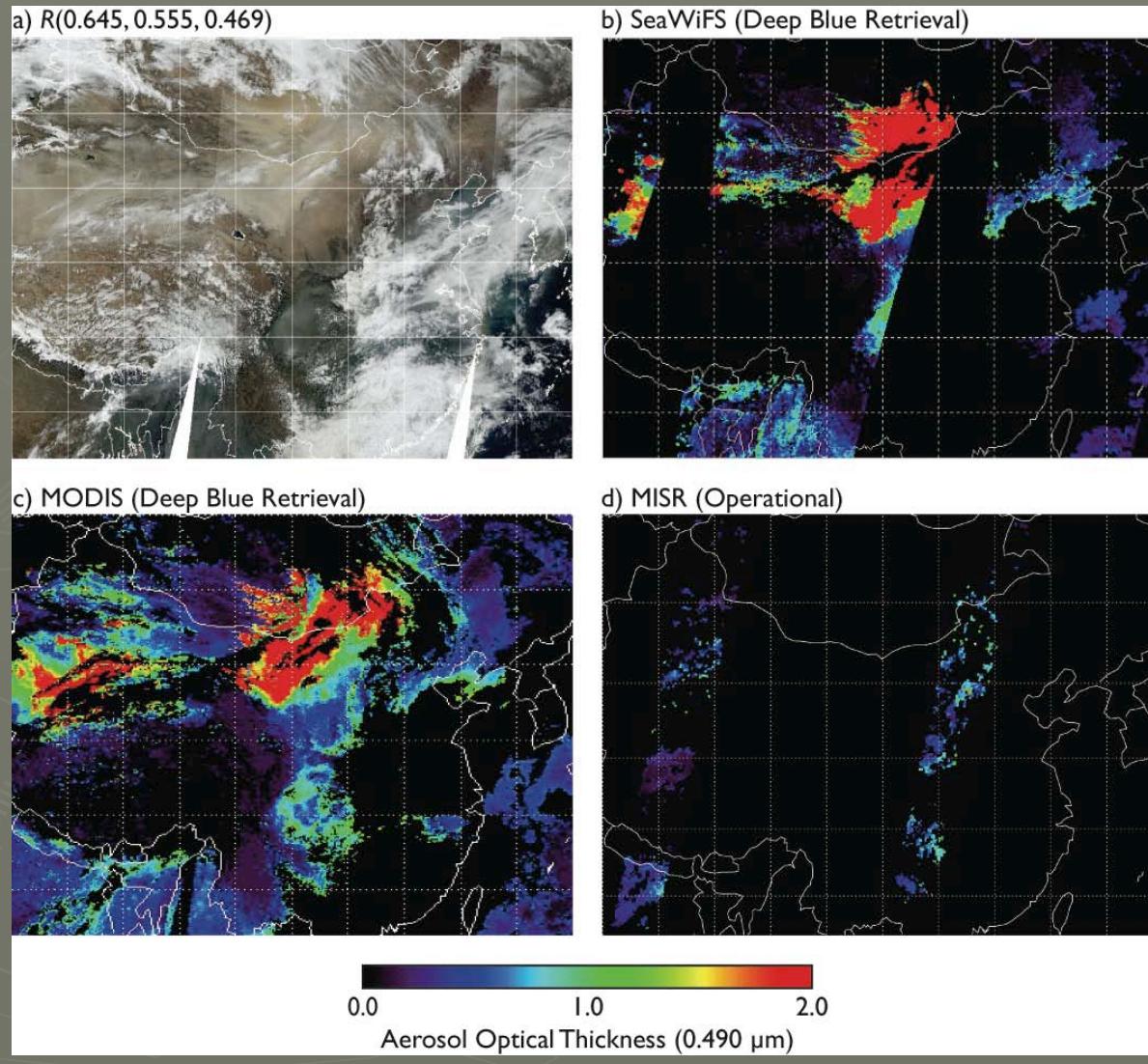
SeaWiFS



Hsu et al. (2004)

Aerosol Optical Thickness of Dust plumes in Asia

(N. C. Hsu, S. C. Tsay, M. D. King, and J. R. Herman - NASA GSFC)

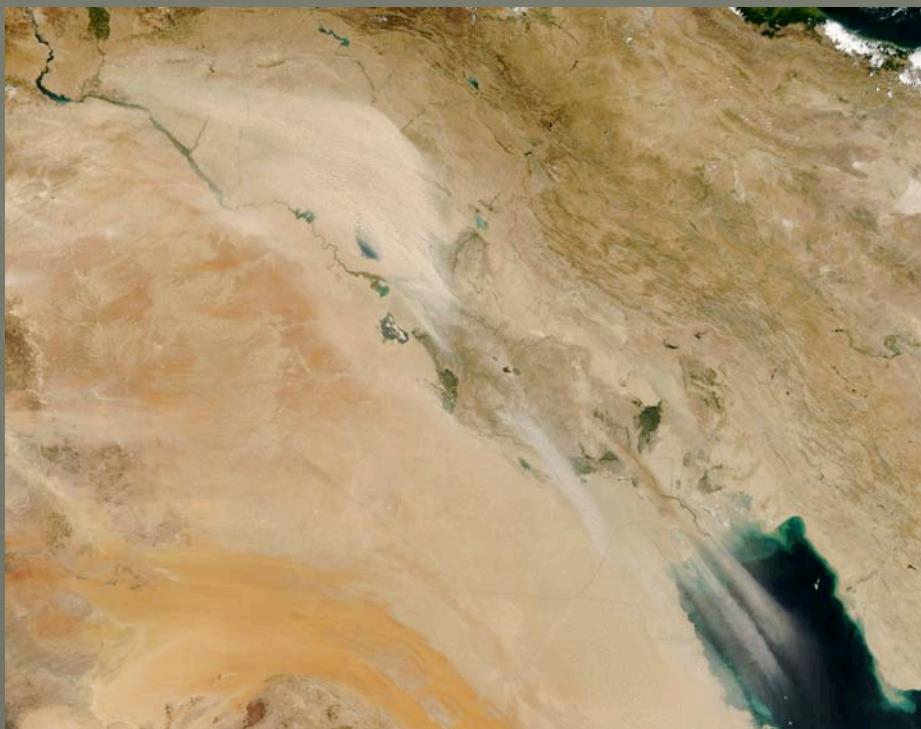


MODIS Deep Blue Algorithm over the Middle East

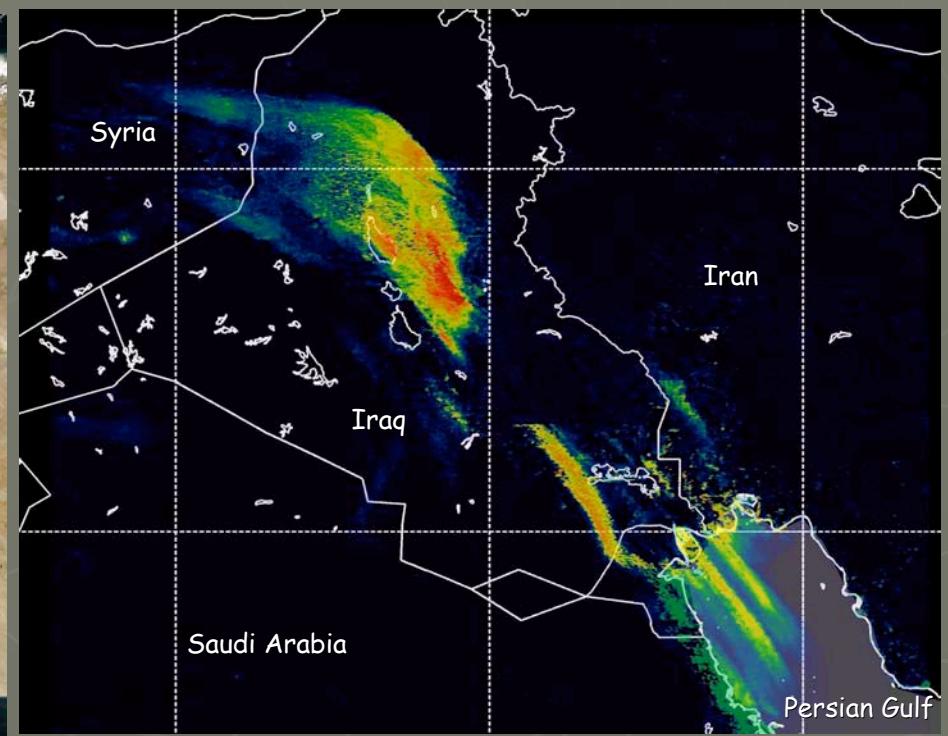
(N. C. Hsu , S. C. Tsay, M. D. King - NASA GSFC)

August 7, 2005

True Color Composite (0.65, 0.56, 0.47)



Aerosol Optical Thickness



Aerosol Optical Thickness

MODIS Precipitable Water Product (**MOD05/MYD05**)

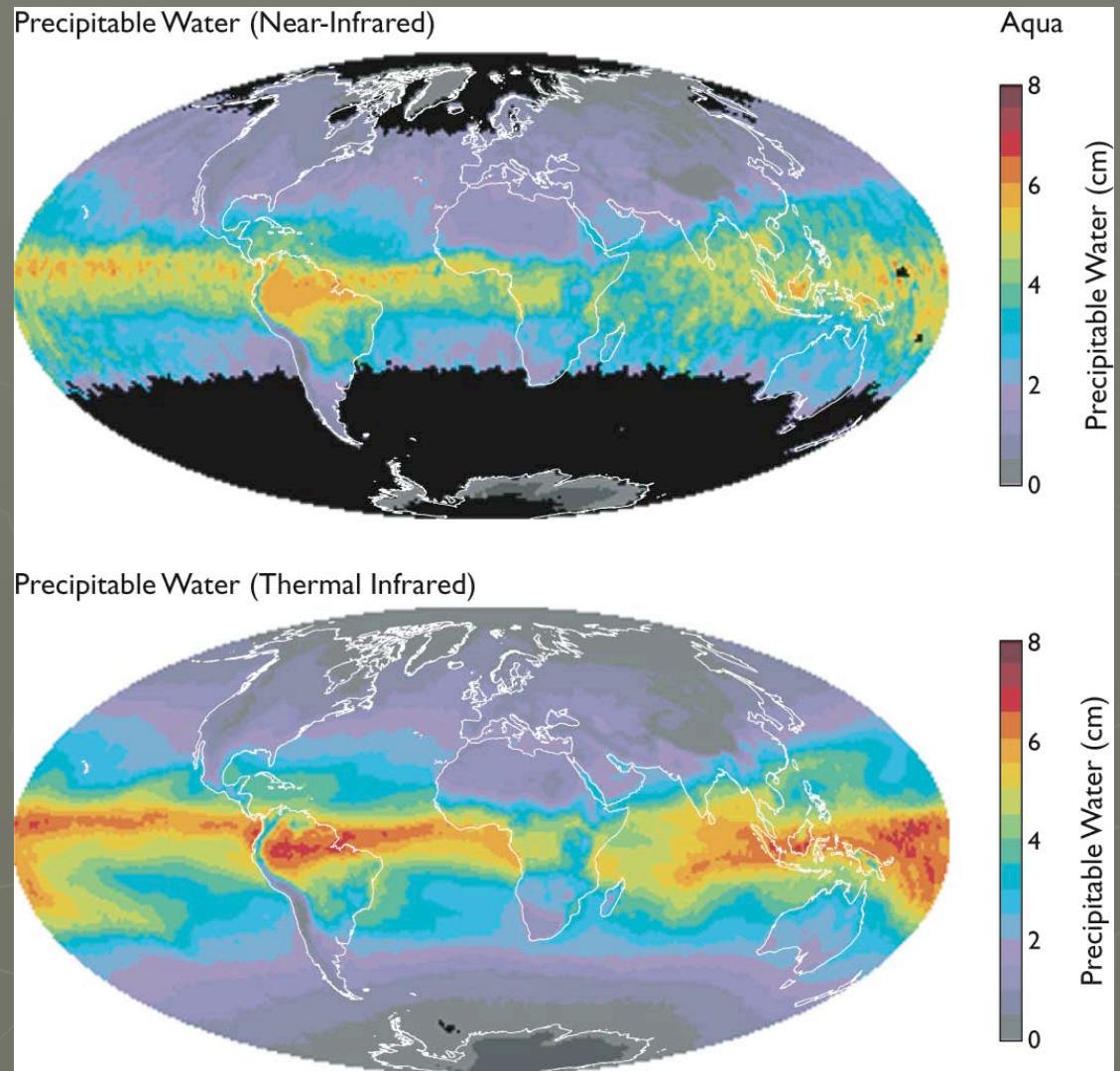
(B. C. Gao, W. P. Menzel, S. W. Seemann - NRL, Univ. Wisconsin)

- Near-infrared water vapor
 - Uses **5 spectral bands** located in and around the $0.94 \mu\text{m}$ water vapor band
 - Retrievals of PW over land and over the ocean with sunglint during the daytime
 - Accuracy of about 7% as compared to ground-based microwave radiometers
- Thermal infrared water vapor
 - Uses **12 spectral bands** ranging from $4.47\text{-}14.24 \mu\text{m}$
 - Algorithm consists of a statistical regression that simultaneously retrieves atmospheric profiles of temperature, water vapor, and ozone
 - For dry atmospheres, MODIS underestimates the total PW, whereas for moist atmospheres MODIS overestimates PW
 - ✓ rms between MODIS and ground-based microwave radiometers is 2.49 mm
 - ✓ bias between MODIS and ground-based microwave radiometers is -0.04 mm

Monthly Mean Precipitable Water

(B. C. Gao, S. W. Seemann, J. Li, W. P. Menzel - NRL, Univ. Wisconsin)

April 2005 (Collection 5)
Aqua



MODIS Atmospheric Profiles Product (MOD07/MYD07)

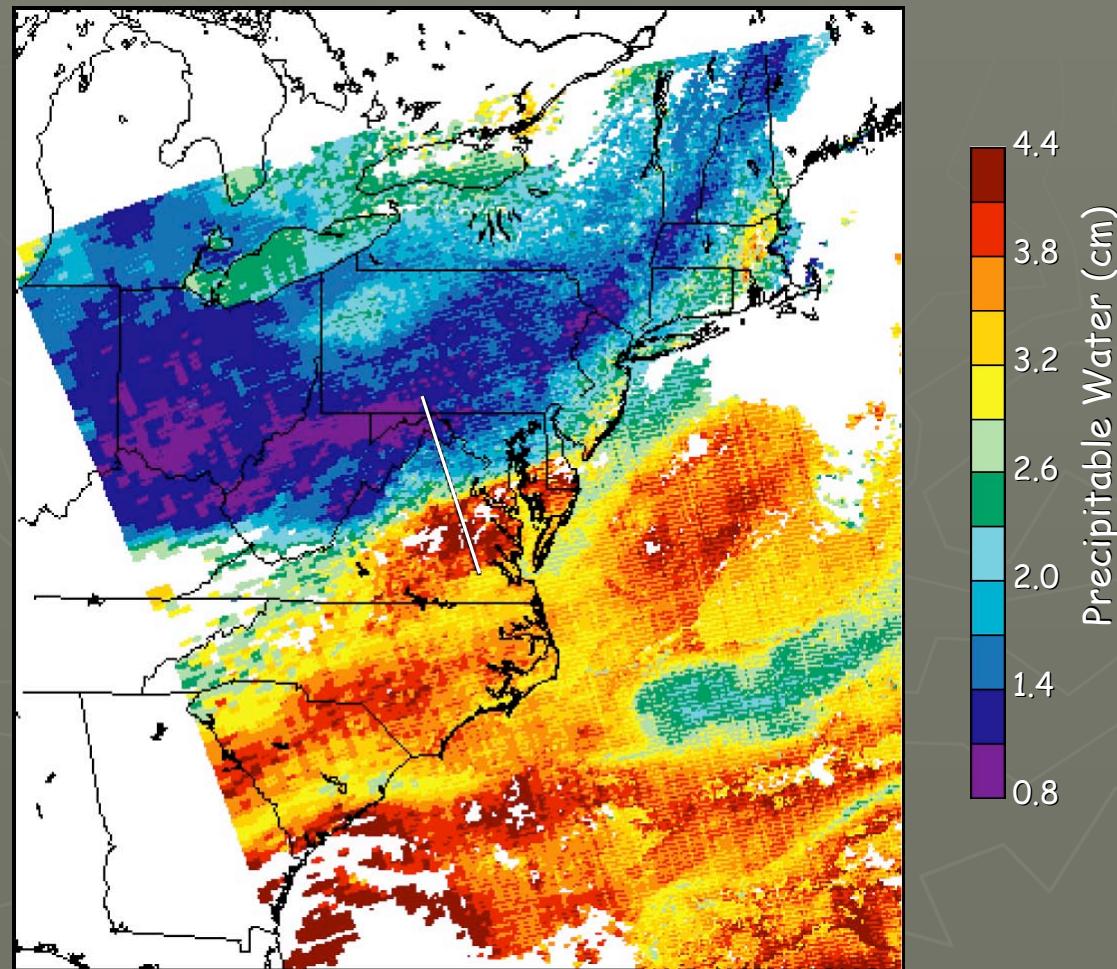
(W. P. Menzel, J. Li, S. W. Seemann - NOAA, Univ. Wisconsin)

- Uses 12 spectral bands ranging from 4.47-14.24 μm
 - Statistical retrievals of atmospheric temperature, moisture layers, total precipitable water, total ozone content, and stability indices
 - ✓ 15,704 profiles used in 'training' dataset
 - Clear sky retrievals are done over land and ocean for both day and night
 - ✓ Surface emissivity based on UW-Madison global gridded IR emissivity dataset at 8 wavelengths (cimss.ssec.wisc.edu/iremis)
 - ✓ 20% of the radiances measured within a 5×5 field of view area (approximately 5 km) are cloud-free
 - Radiative transfer computations are performed over the MODIS bandpass characteristics where the model has 101 pressure-level vertical coordinates
 - ✓ atmospheric profile information is saved at only 20 levels
 - ✓ total precipitable water is computed by integrating over the retrieved profiles with 101 levels

Aqua/MODIS Precipitable Water (MOD05/MYD05)

(S. W. Seemann, J. Li, W. P. Menzel - Univ. Wisconsin, NOAA)

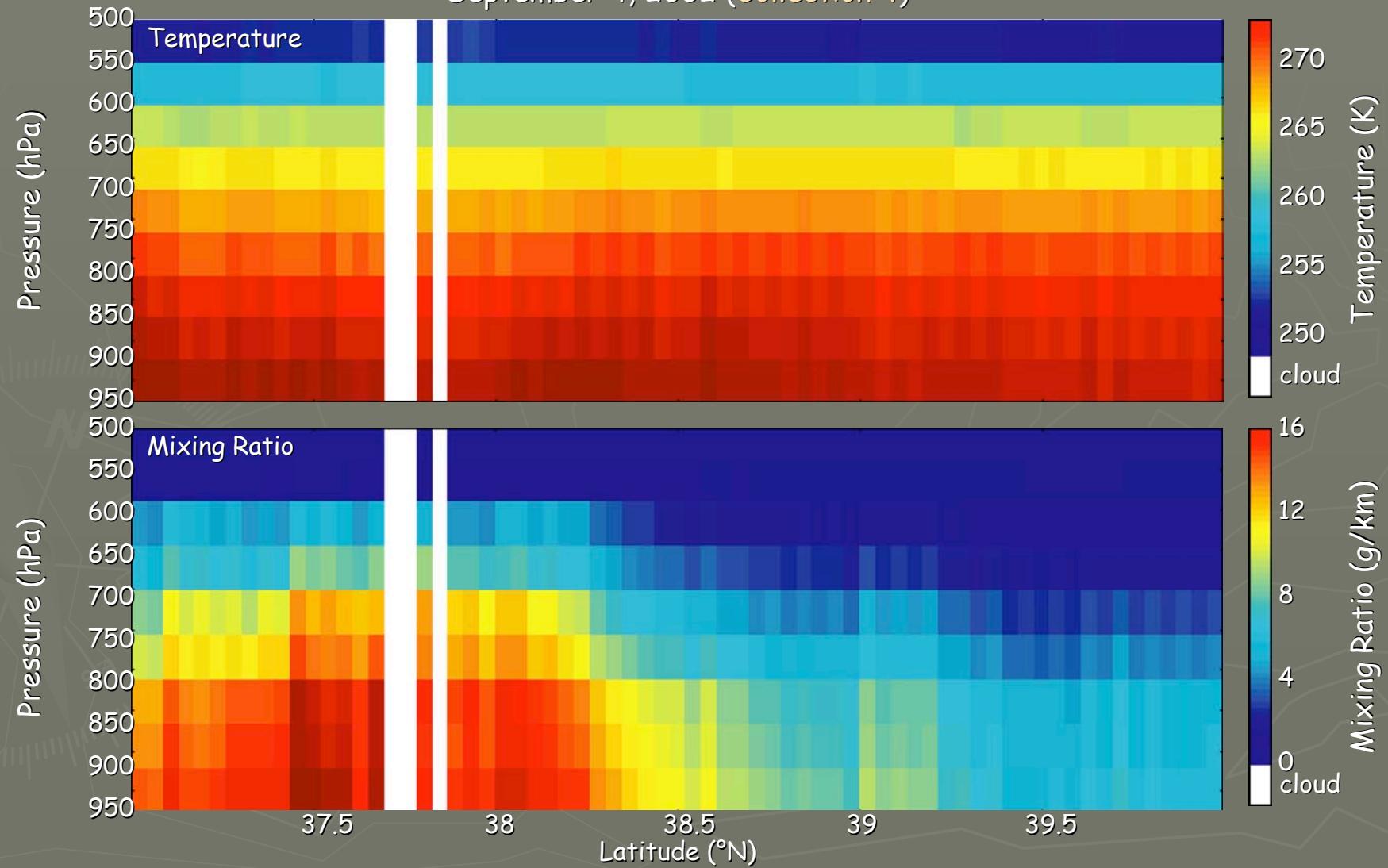
September 4, 2002
(Collection 4)



King et al. (2003)

Aqua/MODIS Profiles of Atmospheric Temperature and Water Vapor Mixing Ratio

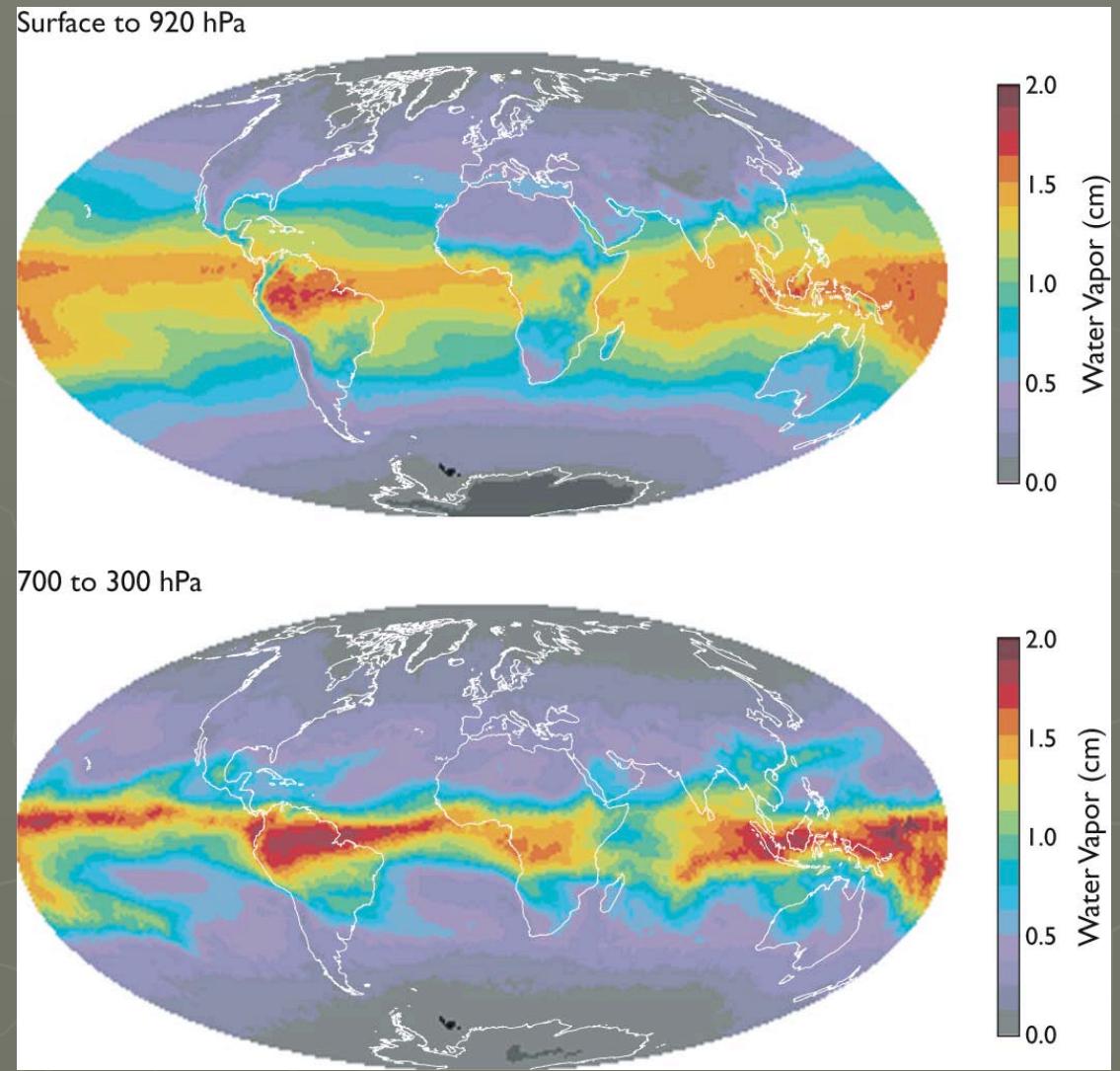
September 4, 2002 (Collection 4)



Monthly Mean Water Vapor

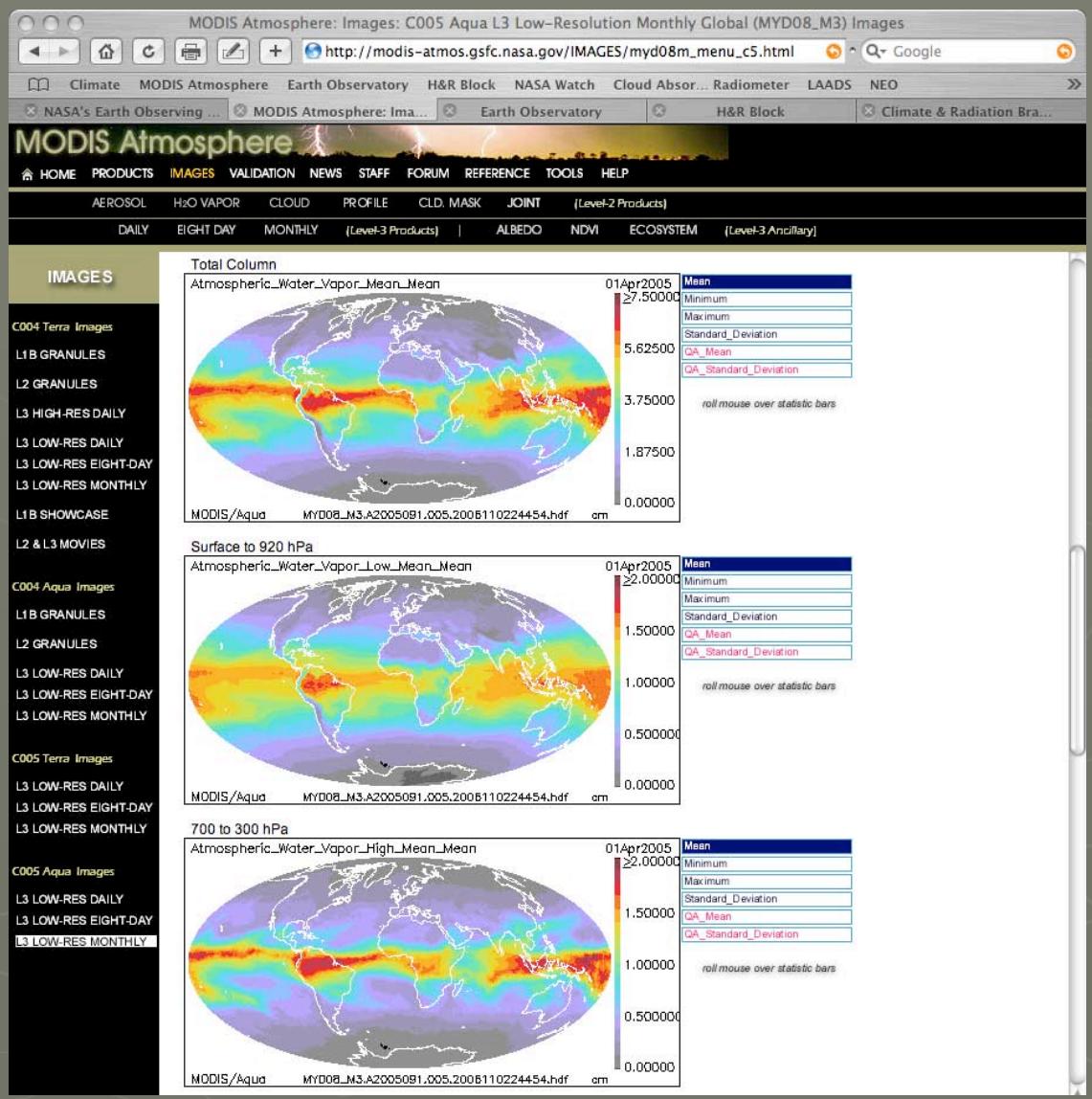
(S. W. Seemann, J. Li, W. P. Menzel - Univ. Wisconsin, NOAA)

April 2005 (Collection 5)
Aqua



MODIS Level-3 Monthly Global Browse Images

- Aerosol Land & Ocean
- Aerosol Land Only
- Aerosol Ocean Only
- Water Vapor
- Cirrus Detection
- Cloud Top Properties
- Cloud Optical Properties
- Atmospheric Profile



Processing and Availability Calendar

MODIS Atmosphere: Products: Processing and Availability Calendar: Overview

http://modis-atmos.gsfc.nasa.gov/products_calendar.html

MODIS Atmosphere

HOME PRODUCTS IMAGES VALIDATION NEWS STAFF FORUM REFERENCE TOOLS HELP

AEROSOL H₂O VAPOR CLOUD PROFILE CLD. MASK JOINT (Level-2 Products)

DAILY EIGHT DAY MONTHLY (Level-3 Products) ALBEDO NDVI ECOSYSTEM (Level-3 Ancillary)

PRODUCTS

OVERVIEW

COLLECTION 5 UPDATE

AVAILABILITY CALENDAR

PGE03 History
PGE04 History
PGE06 History
PGE56 History
PGE57 History
PGE70 History
PGE83 History

ACQUISITION

KNOWN PROBLEMS

HDF FILENAMES

FLOW DIAGRAM

Processing and Availability Calendar

The calendar below offers a month by month overview summary of MODIS Atmosphere data products, color coded to show the Collection level, available for public distribution. A brief summary of the various Collection levels are provided below the calendar. The red numbers in each box reflect the Program Executable (PGE) (aka. science algorithm) version used to produce the latest version of a product (for a non-trivial number of days) for a given month. To view a summary of changes incorporated into each PGE version, click on the red PGE history button at the bottom of any product column or on the appropriate link to the left. (Note that links to the DAAC calendars with day by day detail are offered at the bottom of the page.) The Terra data stream began on February 24, 2000 and the Aqua data stream on July 4, 2002. Note that PGE versions can do vary within given "Collection" versions; and it is important to become familiar with changes made to particular science algorithms during particular MODIS data collections.

As of July 2006, all the *Aqua* MODIS data is available (being distributed) in Collection 005 format. An improved Collection 005 version of *Terra* Cloud Mask data is being distributed for only selected dates.

An improved Collection 005 version of *Terra* products have begun production and are being distributed. Most of this C005 *Terra* data will be available for calendar years 2005 and 2006 initially. Watch the calendar below for processing progress.

All MODIS data products are expected to be available in Collection 005 format by late 2006 or early 2007

To order available data, click on the ACQUISITION link to the left.

Legend:

- = Collection 005
- = Collection 004
- = Not Yet Processed
- = No Instrument Data
- = PGE Version

Last Updated: Tuesday, 19-September-2006 9:00 AM EDT

		Level 2 Products						Level 3 Products			
DATA	DATE	AEROSOL 04_L2	H ₂ O VAPOR 05_L2	CLOUD 06_L2	PROFILE 07_L2	CLD MASK 35_L2	JOINT ATML2	DAILY 08_D3	EIGHT DAY 08_E3	MONTHLY 08_M3	
Y	M JulianDays	Terra	Aqua	Terra	Aqua	Terra	Aqua	Terra	Aqua	Terra	
S	245-274	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
A	214-244	5.2.5	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
J	183-213	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
J	153-182	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
O	122-152	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
M	092-121	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
F	061-091	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
J	001-031	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
D	335-365	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
N	305-334	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
O	274-303	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
S	244-273	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
A	213-243	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
J	182-212	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
O	152-181	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
M	121-151	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
A	091-120	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3
M	060-090	5.2.6	5.2.5	5.2.6	5.2.5	5.11.0	5.11.0	5.2.5	5.2.5	5.3.3	5.3.3

PGE Version

Collection 005 Processing

Summary and Resources

➤ Terra and Aqua

- MODIS atmosphere products (descriptions, level-1b and level-3 browse imagery, documentation, contact information, tools for working with and ordering data...)
 - ✓ modis-atmos.gsfc.nasa.gov
 - » MODIS online visualization and analysis system (Giovanni)
 - » MODIS surface albedo, ecosystem, and NDVI filled-in global data sets
- Collection 5 enhancements and reprocessing
 - ✓ Atmosphere reprocessing of Aqua began on April 1, 2006 (January 2005 to present, then back to beginning of Aqua around July 4, 2002) and is now complete
 - ✓ Atmosphere reprocessing of Terra began on July 18, 2006 (January 2005 to present, then back to beginning of Terra around February 24, 2000) and is now in September 2000
 - ✓ Aqua and Terra forward stream near real-time
 - ✓ Data available for browse (level-1 and atmosphere level-2 and level-3) and ordering at Level 1 and Atmosphere Archive and Distribution System (LAADS)
 - » ladsweb.nascom.nasa.gov